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FLOOD INSURANCE STUDY

MUNICIPALITY OF PENN HILLS, PENNSYLVANIA
ALLEGHENY COUNTY

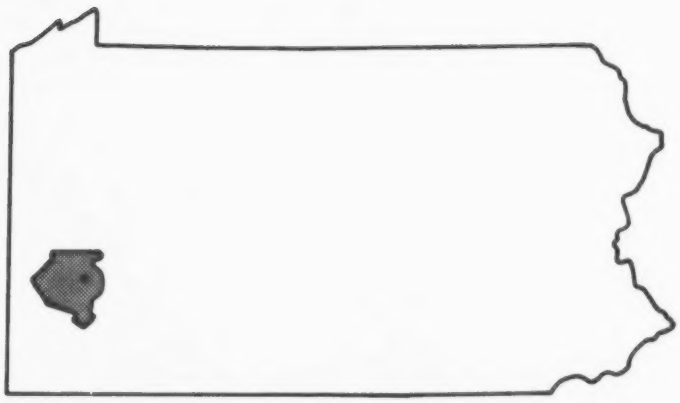

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TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 Purpose of Study	1
	1.2 Authority and Acknowledgements	1
	1.3 Coordination	1
2.0	AREA STUDIED	2
	2.1 Scope of Study	2
	2.2 Community Description	2
	2.3 Principal Flood Problems	5
	2.4 Flood Protection Measures	13
3.0	ENGINEERING METHODS	14
	3.1 Hydrologic Analyses	15
	3.2 Hydraulic Analyses	17
4.0	FLOOD PLAIN MANAGEMENT APPLICATIONS	19
	4.1 Flood Boundaries	19
	4.2 Floodways	20
5.0	INSURANCE APPLICATION	25
	5.1 Reach Determinations	25
	5.2 Flood Hazard Factors	25
	5.3 Flood Insurance Zones	27
	5.4 Flood Insurance Rate Map Description	28

TABLE OF CONTENTS - continued

	Page
6.0 OTHER STUDIES	28
7.0 LOCATION OF DATA	28
8.0 BIBLIOGRAPHY AND REFERENCES	29

FIGURES

Figure 1 - Vicinity Map	3
Figure 2 - Potential 100-year flood elevation on Plum Creek at Mary Street bridge	7
Figure 3 - Potential flood elevations on Plum Creek at Steurnagle Lane bridge	7
Figure 4 - Potential 100-year flood elevation from Plum Creek at Penn Hills Community Park	8
Figure 5 - Potential 100-year flood elevation on Plum Creek at Hulton Road bridge	8
Figure 6 - Potential 100-year flood elevation on Plum Creek at Conrail bridge	9
Figure 7 - Potential 100-year flood elevation on Plum Creek at Leechburg Road bridge	9
Figure 8 - Potential 100-year flood elevation from Plum Creek at Penn Hills Municipal Battlefield Park	10
Figure 9 - Potential 100-year flood elevation from Plum Creek from Penn Hills at golf course	10
Figure 10 - Potential 100-year flood elevation on Sandy Creek at Private Road bridge	11
Figure 11 - Potential 100-year flood elevation on Sandy Creek at Bon Air Products, Inc. building	11

TABLE OF CONTENTS - continued

Page

Figure 12 - Potential 100-year flood elevation on Sandy Creek at Private Drive bridge to Don Kuhn Autobody Repair 12

Figure 13 - Potential 100-year flood elevation on Sandy Creek at Verona road bridge 12

Figure 14 - Floodway Schematic 24

TABLES

Table 1 - Summary of Discharges 16-17

Table 2 - Floodway Data 21-23

Table 3 - Flood Insurance Zone Data 26

EXHIBITS

Exhibit 1 - Flood Profiles

Allegheny River	Panel 01P
Plum Creek	Panels 02P-06P
Sandy Creek	Panels 07P-09P

Exhibit 2 - Flood Boundary and Floodway Map Index

Exhibit 3 - Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index

Flood Insurance Rate Map

FLOOD INSURANCE STUDY
MUNICIPALITY OF PENN HILLS, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Municipality of Penn Hills, Allegheny County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert Penn Hills to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally-supported studies are based. These criteria take precedence over the minimum federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by GAI Consultants, Inc., for the Federal Insurance Administration, under Contract No. H-4762. This work was completed in August 1979.

1.3 Coordination

Streams to be studied by detailed and approximate methods were identified by representatives of the Municipality of Penn Hills, the FIA, and GAI Consultants, Inc. (the study contractor), at the initial Consultation and Coordination Officer's (CCO) meeting on April 4, 1978. The Pittsburgh District of the U. S. Army Corps of Engineers (COE),

the U. S. Geological Survey (USGS), the Southwestern Pennsylvania Regional Planning Commission, the Pennsylvania Department of Transportation, and municipality representatives were contacted throughout the study to obtain information for the hydrologic and hydraulic analyses contained in this report.

The results of the study were reviewed at the final CCO meeting on May 13, 1980, by representatives of the FIA and the Municipality of Penn Hills.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Municipality of Penn Hills, Allegheny County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1).

Detailed methods were used to evaluate flooding hazards on the Allegheny River and Plum Creek throughout the corporate limits; and Sandy Creek, from its mouth to 0.34 mile upstream of Verona Road. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction for the next five years, through August 1984.

Portions of Sandy Creek and Thompson Run were studied by approximate methods. Also studied by approximate methods were the following unnamed tributaries which were assigned numerical designations to facilitate study: Tributary 1 to Chalfant Run, Tributary 1 to Plum Creek, Tributary 1 to Sandy Creek, and Tributary 1 to Thompson Run. In addition, approximate methods were used to study several other unnamed tributaries in Penn Hills. With the exception of two of these tributaries, no flooding was shown on the maps as a result of the approximate study because the headwater flooding on the tributaries represents no significant hazard to the community. Approximate methods of analysis were used to study those areas having low development potential and minimal flood hazards as identified at the initiation of the study. The scope and methods of study were proposed to and agreed upon by the FIA.

2.2 Community Description

The Municipality of Penn Hills is located northeast of the City of Pittsburgh in the east-central portion of Allegheny County, in southwestern Pennsylvania. Penn Hills was originally incorporated as the Township of Adams in 1850. In 1950 it became the Township

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

MUNICIPALITY OF PENN HILLS, PA
(ALLEGHENY CO.)

APPROXIMATE SCALE
6,000 0 6,000 12,000 18,000 FEET

VICINITY MAP

of McNair and in 1951 it was known as the Township of Penn. The community received the name of Penn Hills in 1958. In 1976, the Township of Penn Hills became the Municipality of Penn Hills, its present name. Surrounding communities include the Boroughs of Oakmont and Verona to the north, the Borough of Plum to the northeast, the Borough of Monroeville to the southeast, the Boroughs of Churchill and Wilkinsburg to the south, and the City of Pittsburgh to the west.

The population of Penn Hills increased from 51,512 in 1960 to 62,886 in 1970. Population growth has levelled off in more recent years with a 1975 population estimate of 62,605 persons (References 1 and 2).

Development in Penn Hills is primarily residential and is concentrated in the southern half of the community. Approximately 40 percent of the municipality is undeveloped with about 15 percent of this area being forest. Currently, light industries and commercial establishments comprise most of the nonresidential development. Products manufactured within the community include bakery and dairy goods, printing and publishing materials, cement and concrete products, fabricated metals, and electrical equipment (Reference 2).

Elevations in the township range from 720 feet on the Allegheny River to 1,280 feet at the highest points along the western boundary. The average elevation is approximately 1,100 feet.

The climate of Pennsylvania is considered to be humid continental, but local physiographic features can alter the weather considerably. Most weather systems that affect southwestern Pennsylvania begin in the Central Plains or Midwest and are directed eastward by the prevailing westerly flow. Most of the precipitation in the region is caused by the interaction of these weather systems with moisture-laden air masses from the Gulf of Mexico.

In the vicinity of Penn Hills, the mean daily temperature is 63 degrees Fahrenheit (°F) with mean January and July temperatures of 29°F and 72°F, respectively. Measurable precipitation occurs on approximately 150 days throughout the year. Annual precipitation averages 40 inches with the maximum and minimum monthly averages occurring in May and February, respectively (Reference 3).

The Municipality of Penn Hills is located within the Kanawha section of the Allegheny Plateau physiographic province. This region is characterized by deep V-shaped river and stream valleys and steep hillsides. The municipality is underlain by rock strata of the Conemaugh and Monongahela Formations. The Conemaugh Formation is composed of sequences of red and gray shales and siltstones within

limestones and coals. The Monongahela Formation is composed of sequences of sandstone, shale, limestone, and coal.

The soils in Penn Hills are derived from both the Conemaugh and Monongahela Groups. The soils derived from the latter occupy the more elevated areas of the township. Alluvial flood plain deposits are found along the major streams and include the Allegheny River, Plum Creek, Sandy Creek, Chalfant Run, and Thompson Run. These soils include sands, silts, and sandy and silty clays (Reference 4). The runoff potentials of these soils are moderate to moderately high (References 5, 6, and 7).

The Allegheny River, which forms the northwest boundary of the municipality, originates in northwest Pennsylvania. It flows in a generally southwesterly direction to join the Monongahela River at Pittsburgh to form the Ohio River. The river is approximately 322 miles long and drains 11,748 square miles. The Allegheny River flood plain in Penn Hills is relatively narrow and is not extensively developed.

Plum Creek forms part of the northern and eastern boundary of the municipality and flows in a northwesterly direction to the Allegheny River at the Borough of Oakmont. The creek is 9.0 miles long and drains an area of 20.9 square miles. The area within the Plum Creek watershed is 21 percent developed, 17 percent forest and woodland, 10 percent crop and pasture land, and 52 percent open space (Reference 8).

Sandy Creek is located in the northwest corner of the municipality. It flows northeastward to the Village of Sandy Creek, where it is joined by its main tributaries. It then turns northwestward and enters the Allegheny River at river mile 9.6. Sandy Creek is approximately 2.5 miles long and drains an area of 3.4 square miles. The area within the Sandy Creek watershed is approximately 53 percent developed, 6 percent forest and woodland, and 41 percent open space (Reference 8).

2.3 Principal Flood Problems

Flood flows on the Allegheny River are generated primarily by low intensity storms of long duration. Precipitation from tropical maritime systems, including tropical storms and hurricanes, has been responsible for several major flood events. Spring floods are frequently the result of rain and snowmelt with ice jams creating

localized backwater flooding. Following are the discharges and approximate recurrence intervals of the major floods on the Allegheny River recorded at the gaging station at Lock and Dam No. 4 in Natrona:

Flood	Discharge	Approximate Recurrence Interval (Years)
March 8, 1936	360,500	1,000
December 30, 1942	251,000	100
January 22, 1959	224,000	50
March 10, 1964	218,700	45
January 25, 1937	214,000	35
June 23, 1972	207,000	30

The 1936 flood is the flood of record, with a recurrence interval estimated to be slightly greater than 1,000 years. The most recent major flood caused by Tropical Storm Agnes in June 1972, has a recurrence interval of about 30 years. These recurrence intervals are based on normal operation of all flood control structures presently in use (Reference 9).

There have been relatively few flooding problems along the Allegheny River in the Municipality of Penn Hills. The two areas most affected by the Allegheny River are the Busy Beaver Building Center near the Borough of Verona and the Wilkinsburg-Penn Joint Water Authority pumping station at the intersection of Nadine Road and Allegheny River Boulevard. Neither of these locations were inundated by the flood caused by Tropical Storm Agnes.

Flooding on Plum Creek, Sandy Creek, and the smaller streams within the community is usually caused by high intensity storms of short duration. Summer frontal systems are the primary source of these storms. Occasionally, erratic hurricane movement such as that associated with Tropical Storm Agnes, can cause flooding.

The Penn Hills Community Park, located along Plum Creek, was inundated during Tropical Storm Agnes. Other locations along Plum Creek were also damaged by this flood. Tropical Storm Agnes also caused flooding on Sandy Creek. The bridge for the James Volk Water Pollution Control Plant was overtopped. Sandy Creek Road between the bridge and Allegheny River Boulevard was inundated. Photographs of selected locations along Plum Creek and Sandy Creek are presented in Figures 2 through 13. The photographs illustrate the potential 100-year flood level, as determined by this study, at these locations.

Figure 2 - Potential 100-year flood elevations on Plum Creek at Mary Street bridge, looking upstream at the Mary Street bridge.

Figure 3 - Potential flood elevations on Plum Creek at Steurnagle Lane bridge, looking downstream at Steurnagle Lane bridge. The high-water mark for the June 1972 flood is also shown.

Figure 4 - Potential 100-year flood elevations from Plum Creek at Penn Hills Community Park, looking northeast.

Figure 5 - Potential 100-year flood elevations on Plum Creek at Hulton Road bridge, looking downstream at Hulton Road bridge.

Figure 6 - Potential 100-year flood elevation on Plum Creek at Conrail bridge, looking downstream at Conrail bridge, near the intersection of Plum Street and Hunter Road.

Figure 7 - Potential 100-year flood elevation on Plum Creek at Leechburg Road Bridge, looking downstream at Leechburg Road bridge.

Figure 8 - Potential 100-year flood elevation from Plum Creek at Penn Hills Municipal Battlefield Park, looking northwest at the backstop for the Penn Hills Municipal Ballfield Park, at the confluence of Plum Creek and Little Plum Creek.

Figure 9 - Potential 100-year flood elevation from Plum Creek at golf course - the golf course is on the left bank of Plum Creek in Penn Hills, just downstream of Hulton Road.

Figure 10 - Potential 100-year flood elevation on Sandy Creek at Private Road bridge, looking downstream at bridge to the James Volk Water Pollution Control Plant.

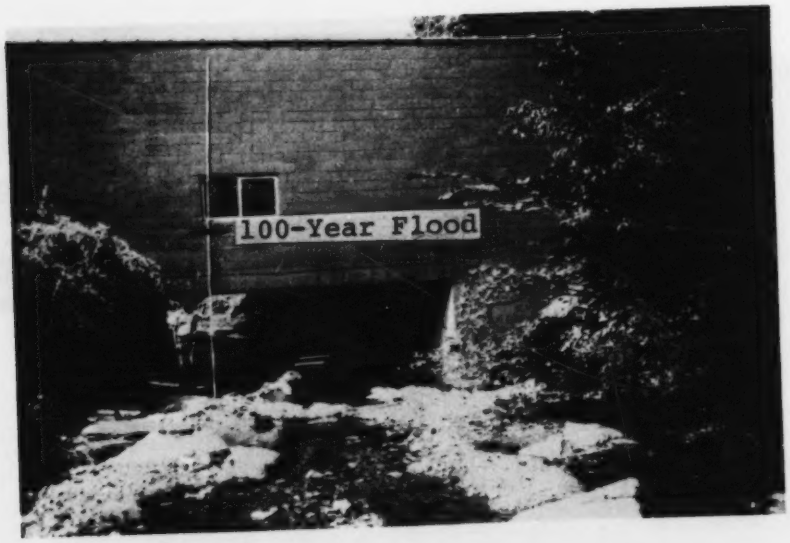


Figure 11 - Potential 100-year flood elevation on Sandy Creek at Bon Air Products, Inc., building, looking downstream at culvert under the Bon Air Products, Inc. building.

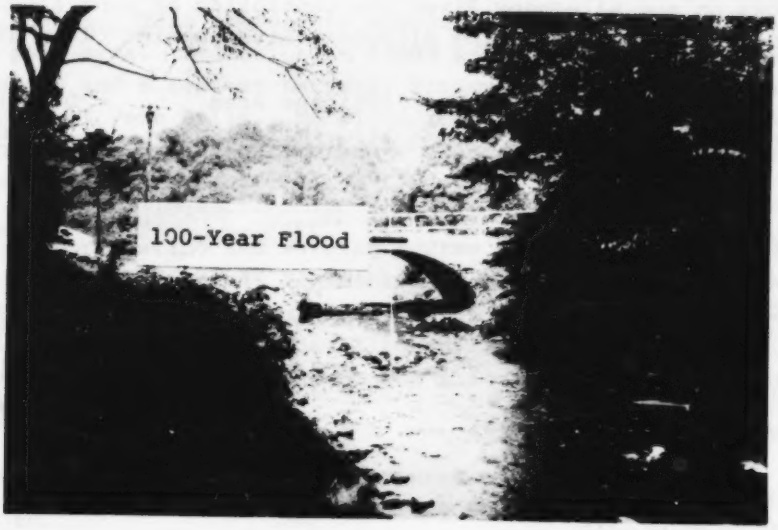


Figure 12 - Potential 100-year flood elevation on Sandy Creek at Private Drive bridge to Don Kuhn Autobody Repair, looking downstream at the bridge.

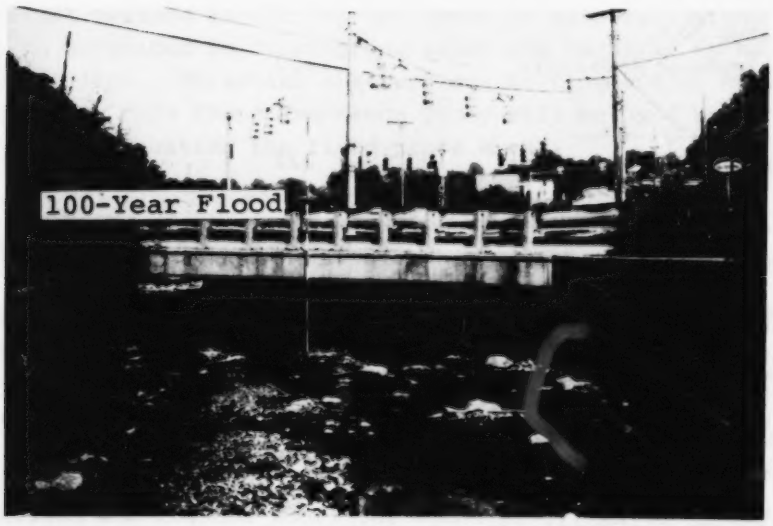


Figure 13 - Potential 100-year flood elevation on Sandy Creek at Verona Road bridg looking downstream at the Verona Road bridge.

2.4 Flood Protection Measures

Flows on the Allegheny River are controlled by nine flood control reservoirs located in the Allegheny River basin. They are as follows:

Dam and Reservoir	Drainage Area (sq. miles)	Date Placed In Operation
Crooked Creek Dam, Crooked Creek Lake	277	June 1940
Tionesta Dam, Tionesta Lake	478	December 1940
Mahoning Dam, Mahoning Creek Lake	340	June 1941
Loyalhanna Dam, Loyalhanna Lake	290	June 1942
East Branch Dam, East Branch Clarion River Lake	72	June 1952
Conemaugh River Dam, Conemaugh River Lake	1,351	November 1953
Kinzua Dam, Allegheny Reservoir	2,180	January 1967
Union City Dam, Union City Reservoir	222	October 1970
Woodcock Dam, Woodcock Creek Lake	46	February 1974

Four of these flood control reservoirs, Crooked Creek Lake, Tionesta Lake, Mahoning Creek Lake and Loyalhanna Lake, were constructed in response to the damage caused by the disastrous St. Patrick's Day flood of March 1936. The five remaining reservoirs were constructed to provide additional flood protection.

Although primarily intended for flood control and recreation, Kinzua Dam also provides hydroelectric (pump storage) power and navigation (References 10 and 11).

These nine reservoirs, which the COE has the responsibility of operating, effectively regulate 5,256 square miles of the Allegheny River basin. This represents approximately 45 percent of the total watershed area. Reduction in flood stage due to these reservoirs is between 4 and 8 feet at Natrona, Pennsylvania, located 13.8 miles upstream of Penn Hills. No significant flood protection is provided by the series of navigation locks and dams on the Allegheny River (Reference 9).

A flood forecasting and warning system is provided by the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service and the Pittsburgh District of the COE to monitor weather conditions and flows in the Allegheny River basin. Emergency operations are coordinated through the Allegheny County Civil Defense Office.

There are no flood control structures on Plum Creek, Sandy Creek, Thompson Run, or Chalfant Run, or on their tributaries.

In February 1976, the Municipality of Penn Hills enacted a flood plain management ordinance setting forth an administrative procedure for controlling activities in the flood plain (Reference 12). The ordinance establishes standards for these activities, and provides for legal enforcement of these standards. The standards set forth in the ordinance cover the types of construction materials to be used in flood-prone areas. The installation of electrical and mechanical systems in flood-prone areas is also regulated. Structures to be placed in flood-prone areas are required to have minimal effect on flow. Potential obstructions to flow and/or debris are prohibited. This Flood Insurance Study will be used by the community in delineating the flood-prone areas.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equalled or exceeded during any year. Although

the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one-percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten) and, for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

Flood flows for the Allegheny River were estimated by the Pittsburgh District of the COE based on a log-Pearson Type III frequency analysis of stage-discharge records covering a 99-year period at or near Lock and Dam No. 4 at Natrona, Pennsylvania (Reference 9). These flows were adjusted to reflect the effects of the upstream flood control reservoirs. The COE estimates were substantiated by comparison to estimates provided by discharge-profile models for regulated streams in Pennsylvania and the most recent log-Pearson Type III frequency analysis at Natrona (References 13, 14 and 15).

Regional flood-flow frequency equations, developed by the Pittsburgh District of the COE, were used to estimate the peak flows for Plum Creek and Sandy Creek. This set of equations relates discharge to drainage area, channel slope; and watershed shape and is applicable to rural watersheds with drainage areas between 0 and 25 square miles. Regression analyses of data from 12 sites with 25 or more years of record, through 1976, within the Allegheny, Monongahela, Beaver, and Ohio River basins were used in developing the equations (Reference 16).

The Plum Creek and Sandy Creek watersheds were determined to be significantly urbanized based on land use data for 1973 (Reference 8). The flood flows determined from the COE equations were increased by nearly 20 percent for Plum Creek and by nearly 40 percent for Sandy Creek to account for this urbanization. A systematic procedure,

based on several research papers on urban hydrology, was used to evaluate the increases (References 17, 18, and [illegible]).

Two indicators of urbanization were used: percentage of development and percentage of imperviousness within the watershed. Developed land was subdivided into three categories, sewered residential, unsewered residential and nonresidential, by a factor representative of its impervious area. It was assumed that sewered residential land was 40 percent impervious, unsewered residential land was 20 percent impervious, and nonresidential land was 85 percent impervious (Reference 20). The word "sewered", as used, was associated with sanitary sewers. The procedure used for evaluating the effects of development on runoff considers developed land to be 100 percent storm sewered. Therefore, all developed land in the Plum Creek and Sandy Creek watersheds was assumed to be storm sewered. Using these criteria and the 1973 land use data, the Plum Creek watershed was estimated to be 21 percent developed and 8 percent impervious and the Sandy Creek watershed was estimated to be 53 percent developed and 25 percent impervious.

The flood-flow estimates, determined as described above for Plum Creek and Sandy Creek, were applicable at their mouths. The estimates for Plum Creek were developed for the entire watershed since Plum Creek was studied in conjunction with three other Flood Insurance Studies (References 21, 22, and 23). Since discharge should decrease as the distance upstream from the downstream limit of detailed study increases (drainage area decreases), these estimates were not suitable for establishing flood elevations along the entire length of each reach. Using the drainage area ratio technique the discharges for selected recurrence interval floods were reduced at points corresponding to drainage area decreases of approximately ten percent or more when just upstream of a major tributary (Reference 14).

A summary of drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
ALLEGHENY RIVER					
At upstream corporate limits	11,560	162,500	232,000	258,000	320,000

TABLE 1 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
PLUM CREEK					
At confluence with Allegheny River	20.9	2,900	4,500	5,300	7,600
3.8 miles upstream of confluence with Allegheny River	17.5	2,525	3,915	4,610	6,615
At confluence with Bodies Run	14.5	2,175	3,375	3,975	5,700
0.9 mile upstream of Bodies Run	12.5	1,915	2,970	3,500	5,015
At confluence with Little Plum Creek	3.5	700	1,080	1,275	1,825
SANDY CREEK					
At confluence with Allegheny River	3.4	1,000	1,750	2,250	3,850
0.8 mile upstream of confluence with Allegheny River	2.9	885	1,500	1,990	3,405
1.1 miles upstream of confluence with Allegheny River	1.2	440	775	995	1,700

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding sources studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of these flooding sources.

Data used for the hydraulic analyses on the Allegheny River were taken from the Flood Insurance Studies for the Township of O'Hara and the Borough of Blawnox (References 24 and 25). This data was checked for accuracy by the study contractor.

Cross-section and bridge data for Plum Creek and Sandy Creek were obtained by field measurement and aerial photogrammetry performed by the study contractor. All bridges and culverts were surveyed to obtain elevation data and structural geometry. Dimensions for the new Milltown Road bridge over Plum Creek, in the Village of Milltown, were obtained from construction drawings furnished by the Bridge Division of the Pennsylvania Department of Transportation. The old bridge collapsed during the winter of 1978-79.

Roughness coefficients (Manning's "n") for the Allegheny River were estimated by the COE in the field and verified through reproduction of the 1936, 1964, and 1972 floods, for which high-water information had been previously obtained. Water-surface profiles for miscellaneous flows were also computed between established rating curves where more definition was required (Reference 13). Within the Municipality of Penn Hills, the channel values ranged from 0.025 to 0.029 and the overbank values were estimated to be 0.050. The roughness coefficients for Plum Creek and Sandy Creek were estimated by field inspection and comparison to similar streams (Reference 26 and 27). Within the Municipality of Penn Hills, the Plum Creek channel values ranged from 0.025 to 0.040 and the overbank values ranged from 0.033 to 0.090. For Sandy Creek, the channel values ranged from 0.025 to 0.038 and the overbank values ranged from 0.030 to 0.150.

Water-surface elevations of the selected floods were estimated using the COE HEC-2 step-backwater computer program (Reference 28). The program computes and plots the water-surface profiles for river channels of any cross section. The effects of various hydraulic structures such as bridges, culverts, weirs, embankments, and dams can be evaluated. The program is an application of Bernoulli's Theorem for the total energy at each cross section, with Manning's formula used to evaluate the head loss between cross sections.

The hydraulic analysis for the Allegheny River was performed in conjunction with two other Flood Insurance Studies (References 24 and 25). For the Allegheny River, the computations began at river mile 6.7 and ended at river mile 18.6. The starting water-surface elevations were obtained from the Flood Insurance Study for the Township of O'Hara (Reference 24).

The hydraulics for Plum Creek were performed in conjunction with three other Flood Insurance Studies (References 21, 22, and 23). For Plum Creek, the analysis covered an 8.3 mile reach beginning at its mouth. A rating curve for the Allegheny River Boulevard bridge in Verona was used to establish the starting water-surface elevations. The rating curve was developed by treating the bridge as a box culvert (Reference 29).

Starting water-surface elevations for the Sandy Creek hydraulic analysis were estimated using the standard slope/area method outlined in the HEC-2 Users Manual (Reference 28).

The flood elevations for those streams studied by approximate methods were derived by one or a combination of the following methods:

(a) Estimating the flood elevations based on flood boundaries shown on the Flood Hazard Boundary Map (FHBM) (Reference 30).
(b) Extrapolation from detailed hydraulic analyses performed on the respective streams.
(c) Estimating the 100-year elevation for representative valley cross sections from USGS topographic maps based on normal depth calculations (Reference 31). The elevations derived from the normal depth calculations were estimated using the flood flow frequency equations developed by the COE (Reference 16).

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 3).

All elevations used in this study are referenced to the National Geodetic Vertical Datum of 1929 (NGVD), formerly referred to as Sea Level Datum of 1929. Locations of the elevation reference marks used in the study are shown on the maps.

The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are valid only if hydraulic structures remain unobstructed, and dams and other flood control structures operate properly and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year

flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:2,400 with a contour interval of 4 feet (Reference 32). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year boundary has been shown.

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 3). Small areas within the flood boundaries may lie above the flood elevations and, therefore, may not be subject to flooding. Owing to limitations of the map scale and lack of detailed topographic data, such areas are not shown.

For each stream studied by approximate methods the boundaries of the 100- and 500-year floods have been delineated using the flood elevations obtained from extrapolation of the detailed analyses, normal depth calculations and determined from the FHBM. The boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (Reference 31). For some of the small streams studied by approximate methods, flood boundaries shown on the FHBM were deleted where flooding was found to be negligible.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood can be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this report are presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

The floodways presented in this study were primarily computed on the basis of equal conveyance reduction from each side of the flood plains. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 2).

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH [3] (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Allegheny River								
A	0.720 [1]	1182/423	36,538	7.1	739.9	739.9	740.8	0.9
B	1.048 [1]	1126/575	42,014	6.1	740.3	740.3	741.2	0.9
C	1.455 [1]	1893/1023	56,648	4.6	740.8	740.8	741.8	1.0
D	1.889 [1]	2188/1078	59,818	4.3	741.0	741.0	742.0	1.0
E	2.105 [1]	2190/922	64,465	4.0	741.1	741.1	742.1	1.0
Plum Creek								
A	175 [2]	164/139	700	7.6	750.4	750.4	750.4	0.0
B	875 [2]	190/45	635	8.4	752.6	752.6	752.8	0.2
C	1,902 [2]	138/68	530	10.0	758.1	758.1	758.1	0.0
D	2,922 [2]	283/28	1,309	4.0	763.4	763.4	763.4	0.0
E	4,522 [2]	313/98	1,096	4.8	773.7	773.7	773.8	0.1
F	5,672 [2]	232/200	678	7.8	779.6	779.6	779.6	0.0
G	7,202 [2]	167/60	512	10.4	788.5	788.5	788.5	0.0
H	7,917 [2]	146/35	596	8.9	792.4	792.4	792.5	0.1
I	10,432 [2]	118/30	791	6.7	804.4	804.4	805.4	1.0
J	12,342 [2]	210/40	998	5.3	817.3	817.3	818.2	0.9
K	14,147 [2]	160/100	659	7.0	830.1	830.1	830.1	0.0
L	15,690 [2]	112/90	434	10.6	841.4	841.4	841.4	0.0

[1] Miles above corporate limits
[2] Feet above corporate limits
[3] Width/width within corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

MUNICIPALITY OF PENN HILLS, PA
(ALLEGHENY CO.)

FLOODWAY DATA

ALLEGHENY RIVER AND PLUM CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Plum Creek (continued)								
M	17,180[1]	89/65[3]	484	9.5	851.5	851.5	851.7	0.2
N	17,879[1]	81/35[3]	774	6.0	860.8	860.8	860.8	0.0
O	18,748[1]	200/175[3]	682	6.8	865.2	865.2	865.2	0.0
P	20,588[1]	72/22[3]	403	9.9	871.0	871.0	871.9	0.9
Q	22,098[1]	65/45[3]	386	10.3	880.5	880.5	880.5	0.0
R	24,186[1]	175/150[3]	707	5.6	888.3	888.3	888.4	0.1
S	24,635[1]	120/20[3]	962	3.6	895.1	895.1	895.3	0.2
T	25,686[1]	140/20[3]	893	3.9	897.0	897.0	897.6	0.6
U	26,826[1]	545/375[3]	4,265	0.8	905.6	905.6	906.3	0.7
V	27,092[1]	288/270[3]	1,695	0.8	905.6	905.6	906.3	0.7
W	27,942[1]	46/28[3]	144	8.9	905.9	905.9	906.3	0.4
X	28,104[1]	52/17[3]	168	7.6	907.7	907.7	908.0	0.3
Y	28,744[1]	46/12[3]	146	8.7	915.9	915.9	915.9	0.0
Z	28,944[1]	24/12[3]	111	11.5	917.5	917.5	917.5	0.0
Sandy Creek								
A	580[2]	64	441	5.1	740.8	738.5[4]	738.5	0.0
B	1,240[2]	28	164	13.8	746.4	746.4	747.4	1.0

[1] Feet above corporate limits
[2] Feet above confluence with Allegheny River
[3] Width/width within corporate limits
[4] Elevation computed without consideration of backwater effects from Allegheny River

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

MUNICIPALITY OF PENN HILLS, PA
(ALLEGHENY CO.)

FLOODWAY DATA

PLUM CREEK AND SANDY CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Sandy Creek (continued)								
C	2,220	62	371	6.1	761.5	761.5	761.5	0.0
D	2,720	35	176	12.8	765.8	765.8	765.8	0.0
E	2,920	225	896	2.5	773.3	773.3	774.2	0.9
F	4,020	33	158	12.6	791.5	791.5	791.5	0.0
G	4,470	67	301	6.6	798.0	798.0	798.0	0.0
H	5,030	37	165	12.0	805.9	805.9	805.9	0.0
I	5,210	36	262	7.6	814.0	814.0	814.0	0.0
J	5,410	33	188	10.6	814.5	814.5	814.5	0.0
K	5,580	118	517	3.8	821.0	821.0	821.0	0.0
L	5,735	33	141	7.1	821.0	821.0	821.1	0.1
M	6,265	29	95	10.4	831.1	831.1	831.1	0.0
N	7,315	30	97	10.3	855.0	855.0	855.0	0.0

[1] Feet above confluence with Allegheny River

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

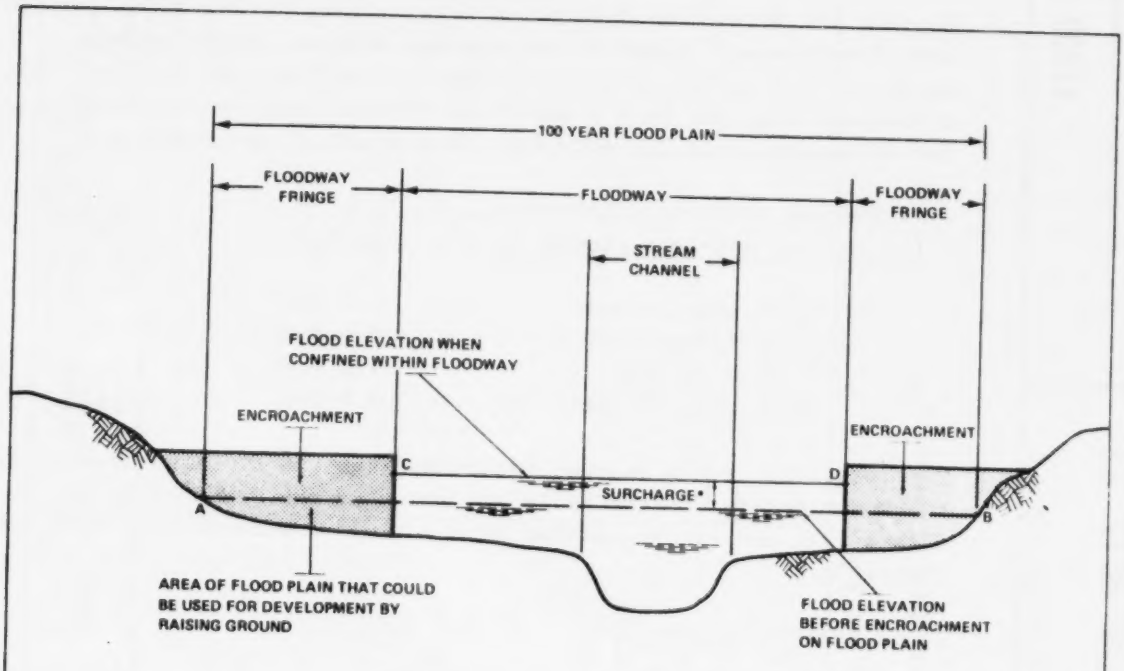
MUNICIPALITY OF PENN HILLS, PA
(ALLEGHENY CO.)

FLOODWAY DATA

SANDY CREEK

As shown on the Flood Boundary and Floodway Map (Exhibit 3), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown. Part of the floodway boundary for the Allegheny River lies outside the corporate limits of Penn Hills in the adjacent communities of the Township of O'Hara and the Borough of Blawnox. Part of the floodway boundary for Plum Creek also lies outside Penn Hills in the adjacent communities of the Boroughs of Plum and Oakmont.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 14.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 4

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "With Floodway" elevations presented in Table 2 for certain downstream cross sections of Sandy Creek are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for each flooding source affecting the Municipality of Penn Hills.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of the Municipality of Penn Hills are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 3).

5.2 Flood Hazard Factors

The FHF is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Allegheny River							
Reach 1	01,02,03	-7.3	-2.2	+5.1	075	A15	Varies
Plum Creek							
Reach 1	03	-1.9	-0.5	+1.0	020	A4	Varies
Reach 2	03	-1.4	-0.3	+0.8	015	A3	Varies
Reach 3	03	-2.1	-0.5	+0.9	020	A4	Varies
Reach 4	03	-1.7	-0.5	+1.2	015	A3	Varies
Reach 5	03,05	-2.4	-0.7	+1.7	025	A5	Varies
Reach 6	05	-4.3	-1.1	+2.7	045	A9	Varies
Reach 7	05	-1.6	-0.5	+2.3	015	A3	Varies
Sandy Creek							
Reach 1	02	-2.8	-1.1	+2.2	030	A6	Varies
Reach 2	02	-2.2	-1.0	+1.4	020	A4	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted average
[3]Rounded to the nearest foot - see map

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

MUNICIPALITY OF PENN HILLS, PA
(ALLEGHENY CO.)

FLOOD INSURANCE ZONE DATA

ALLEGHENY RIVER, PLUM CREEK AND SANDY CREEK

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of Penn Hills was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zones A3, A4, A5, A6, A9 and A15:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHF.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also, areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Municipality of Penn Hills is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

The COE published the Flood Plain Information report for Allegheny County, Pennsylvania (Reference 9) in March 1973. The Allegheny River within the Township of Penn Hills was included in this report.

The Flood Hazard Boundary Map for the Municipality of Penn Hills was published in 1975 (Reference 30).

Flood Insurance Studies are currently being conducted for the City of Pittsburgh, the Township of O'Hara, and the Boroughs of Blawnox, Oakmont, Verona and Plum (References 13, 24, 25, 21, 22 and 23). A Flood Insurance Study for the Borough of Monroeville has been completed (Reference 33). The results of this study will be in agreement with the results of these studies when all are completed.

This study is authoritative for purposes of the Flood Insurance Program, and the data presented here either supersede or are compatible with previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this report can be obtained by contacting the office of the Insurance and Mitigation Division of the Federal Emergency Management Agency, Regional Director, Region III Office, Curtis Building, Sixth and Walnut Streets, Philadelphia, Pennsylvania 19106.

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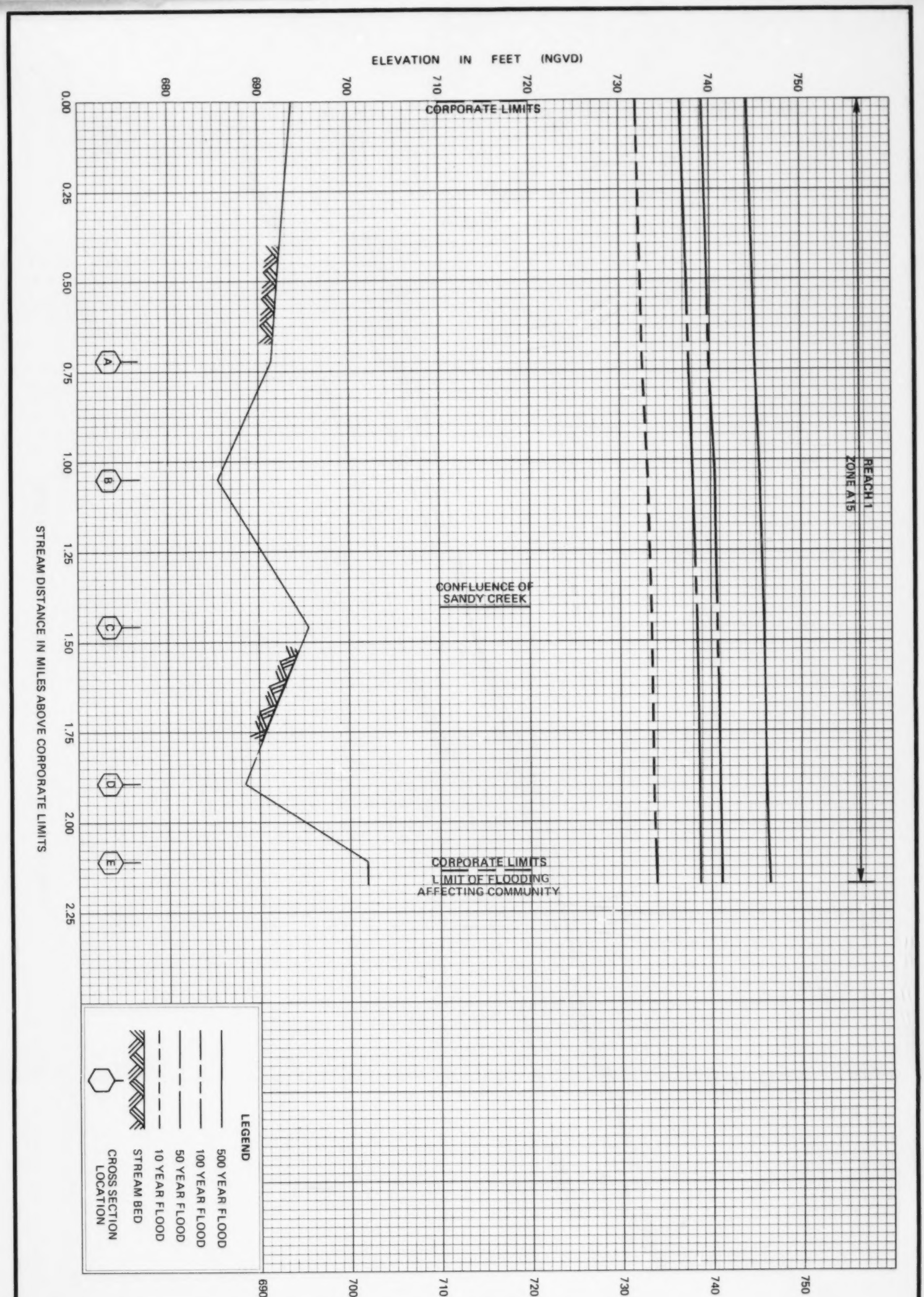

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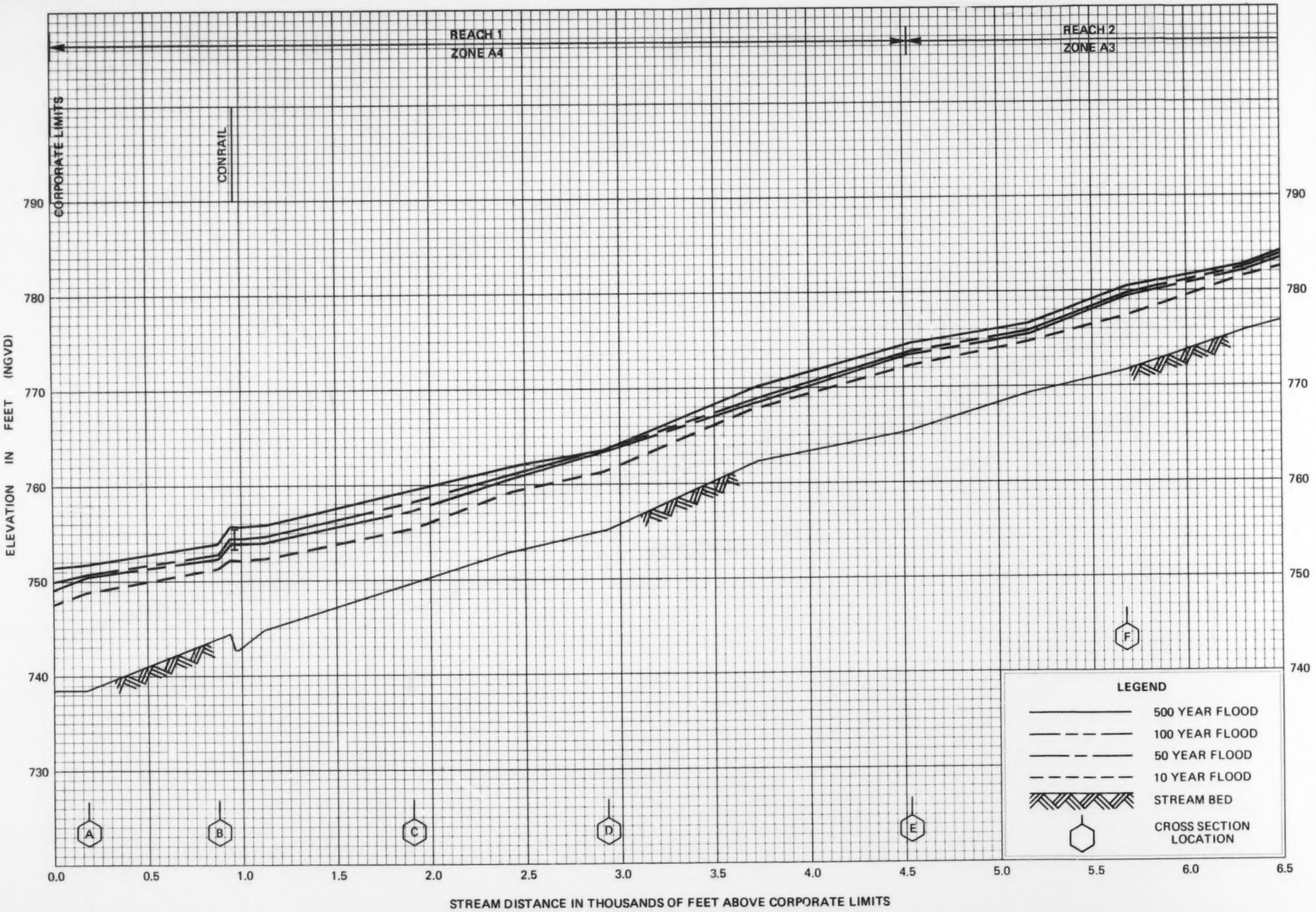
FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

MUNICIPALITY OF PENN HILLS, PA
(ALLEGHENY CO.)

FLOOD PROFILES

ALLEGHENY RIVER



FLOOD PROFILES

PLUM CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

MUNICIPALITY OF PENN HILLS, PA
(ALLEGHENY CO.)

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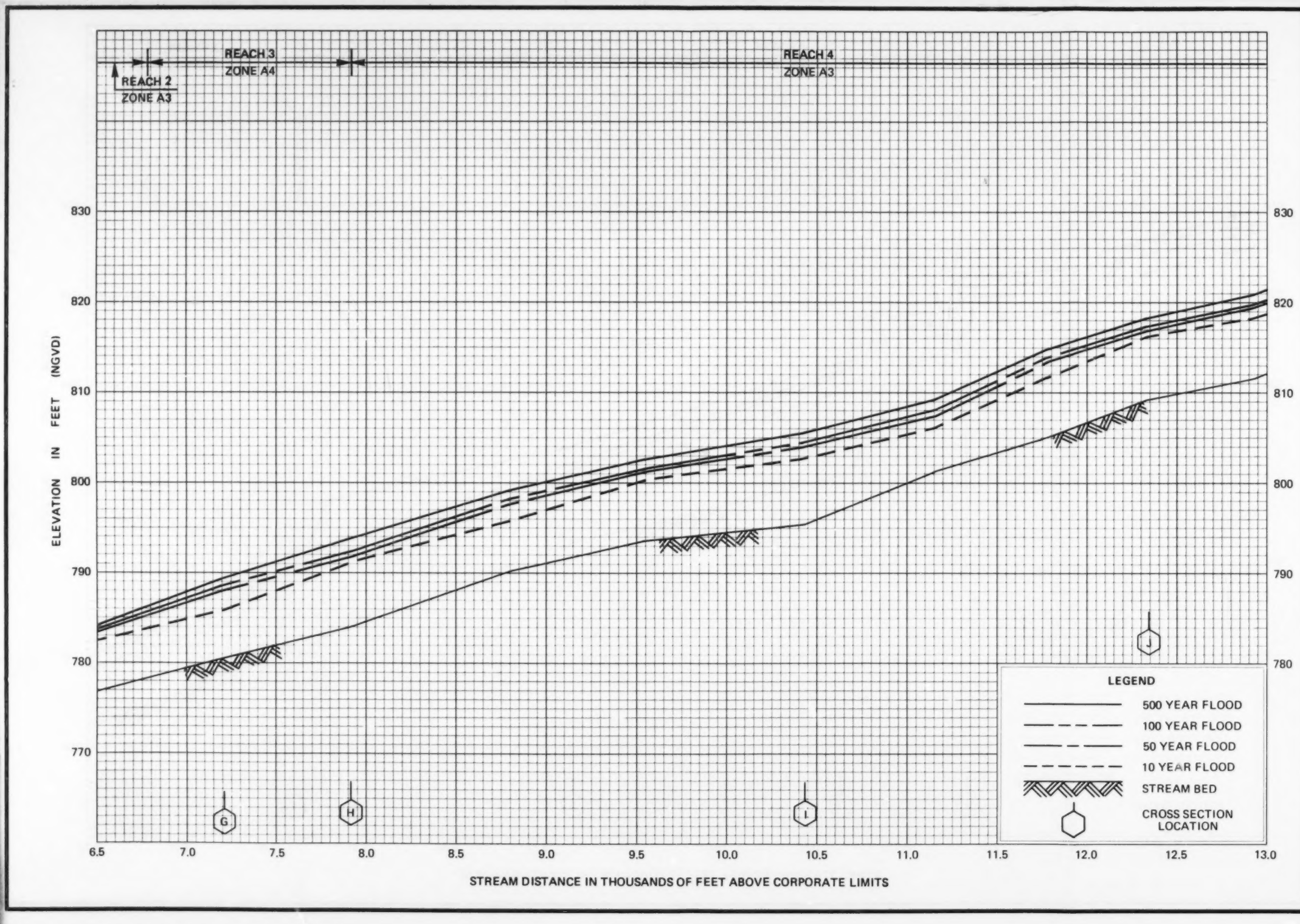


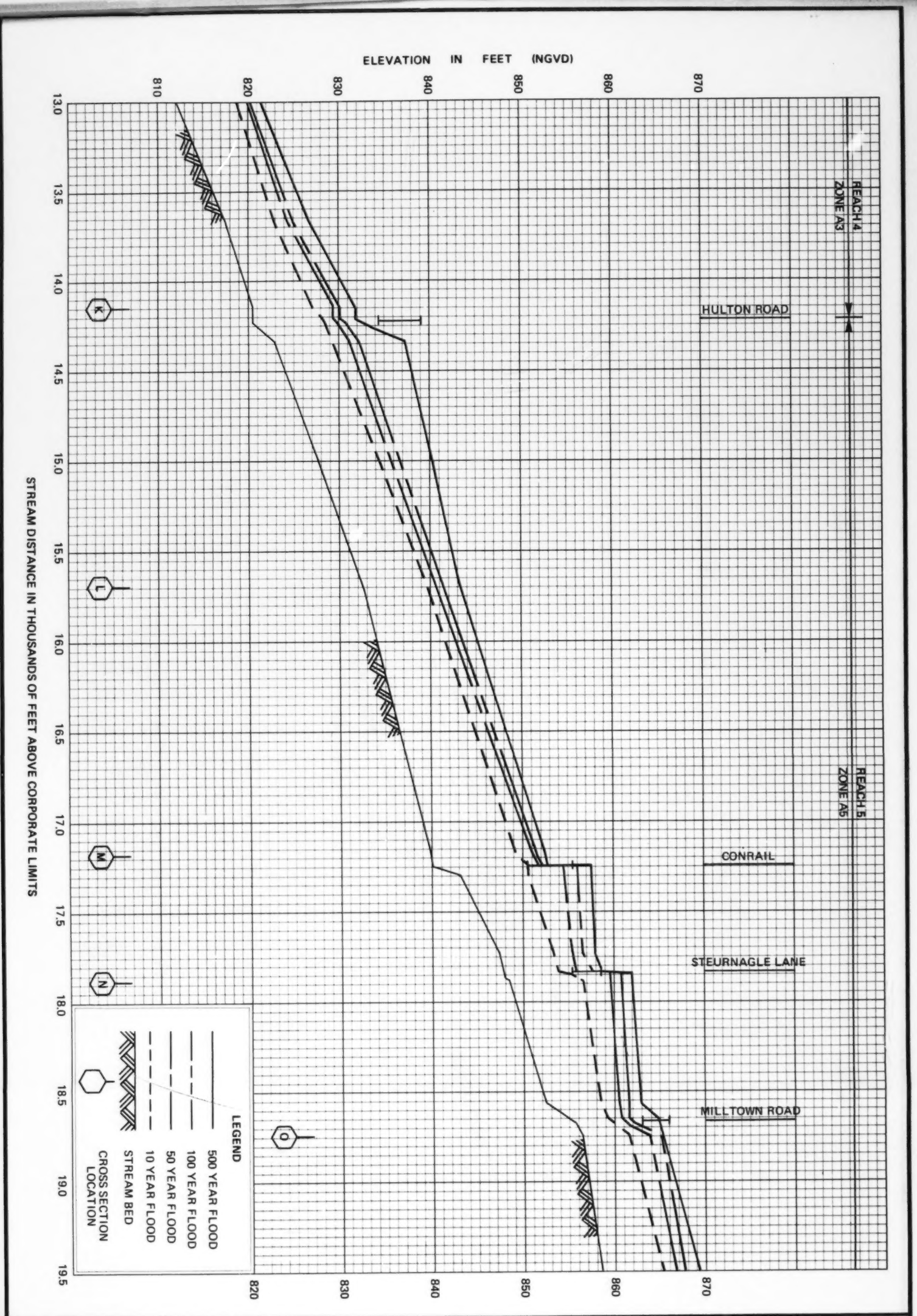
FLOOD PROFILES

PLUM CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

MUNICIPALITY OF PENN HILLS, PA
(ALLEGHENY CO.)

03P



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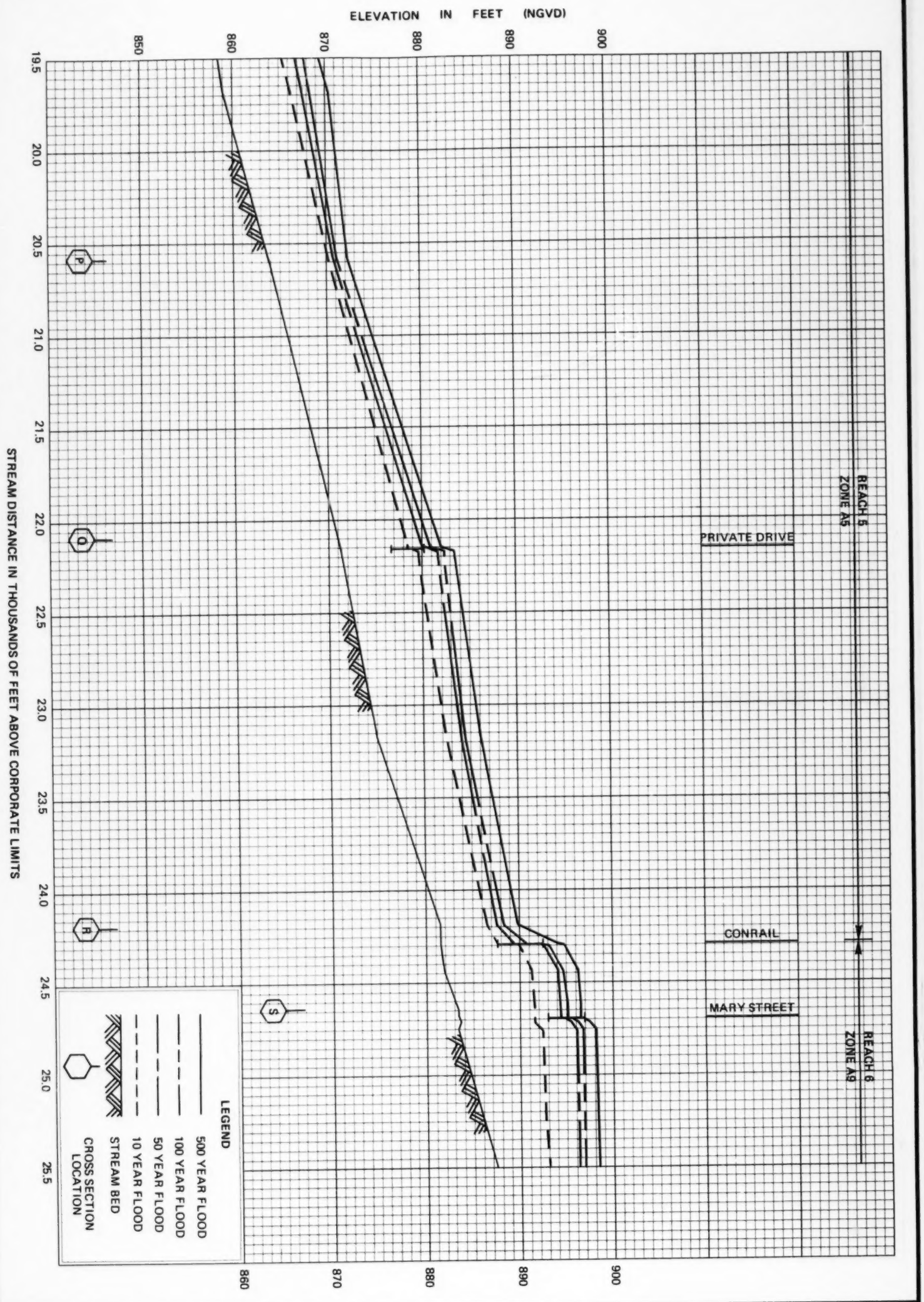
FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

MUNICIPALITY OF PENN HILLS, PA
(ALLEGHENY CO.)

FLOOD PROFILES

PLUM CREEK



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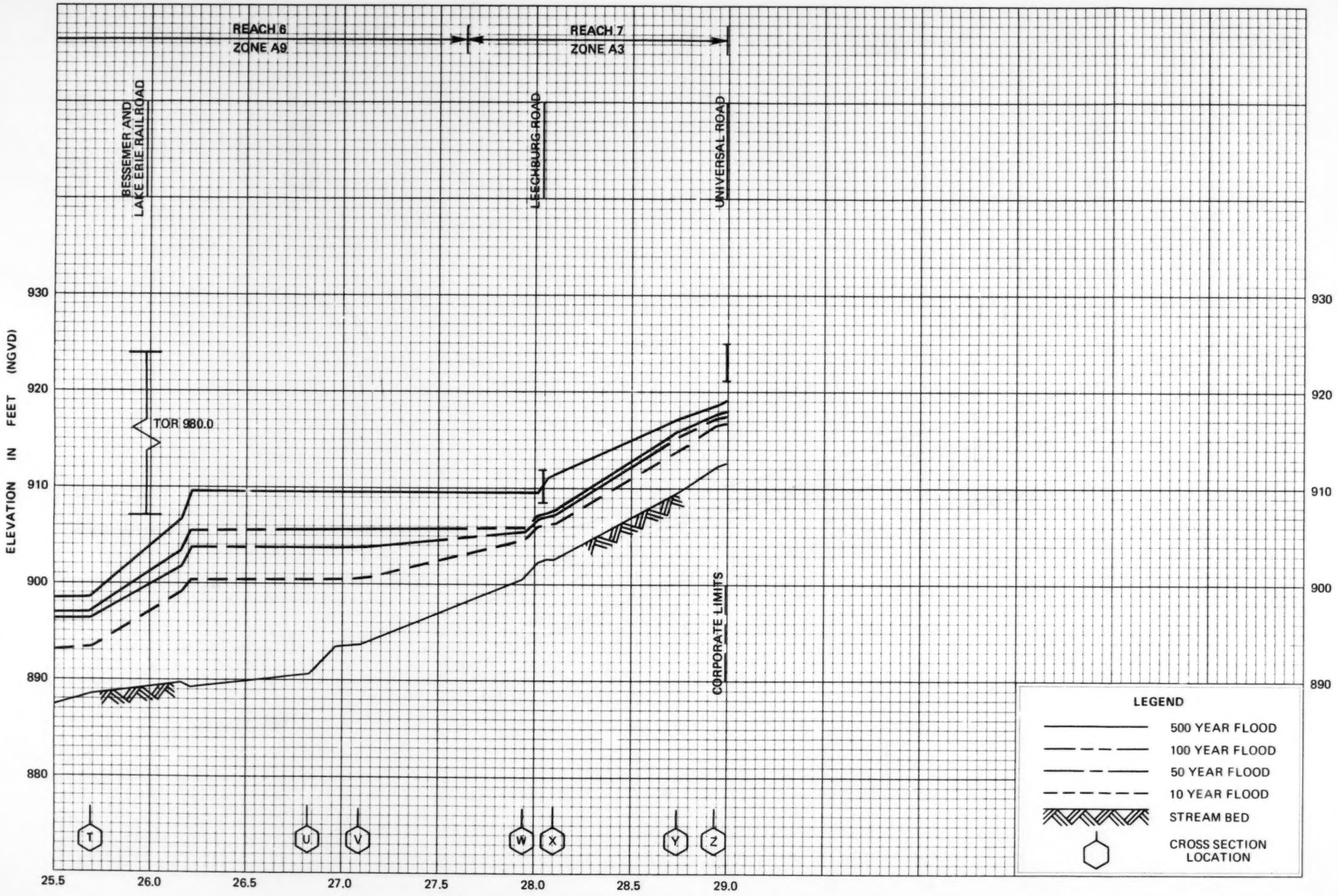
FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

MUNICIPALITY OF PENN HILLS, PA
(ALLEGHENY CO.)

FLOOD PROFILES

PLUM CREEK



FLOOD PROFILES

PLUM CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

MUNICIPALITY OF PENN HILLS, PA
(ALLEGHENY CO.)

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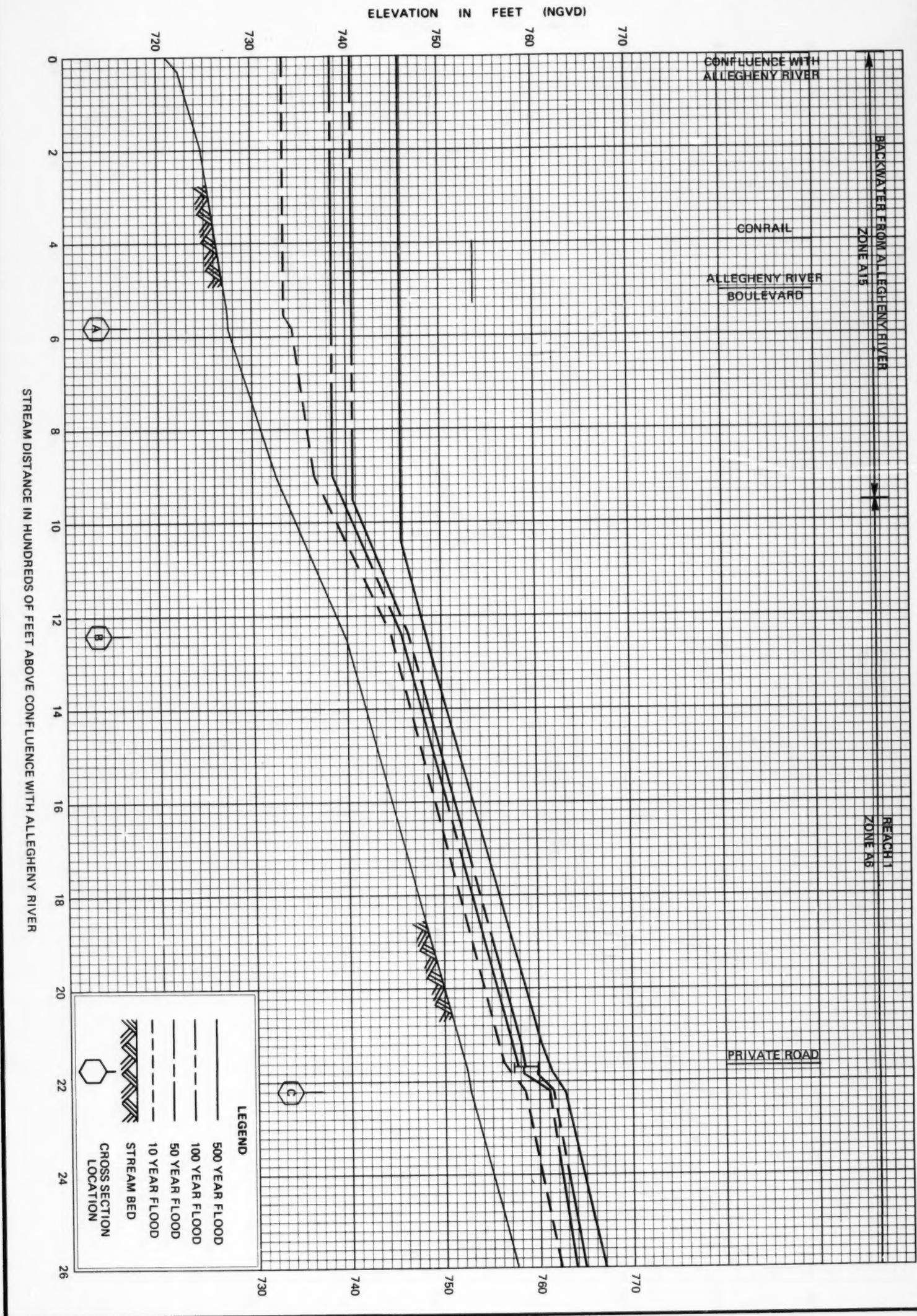

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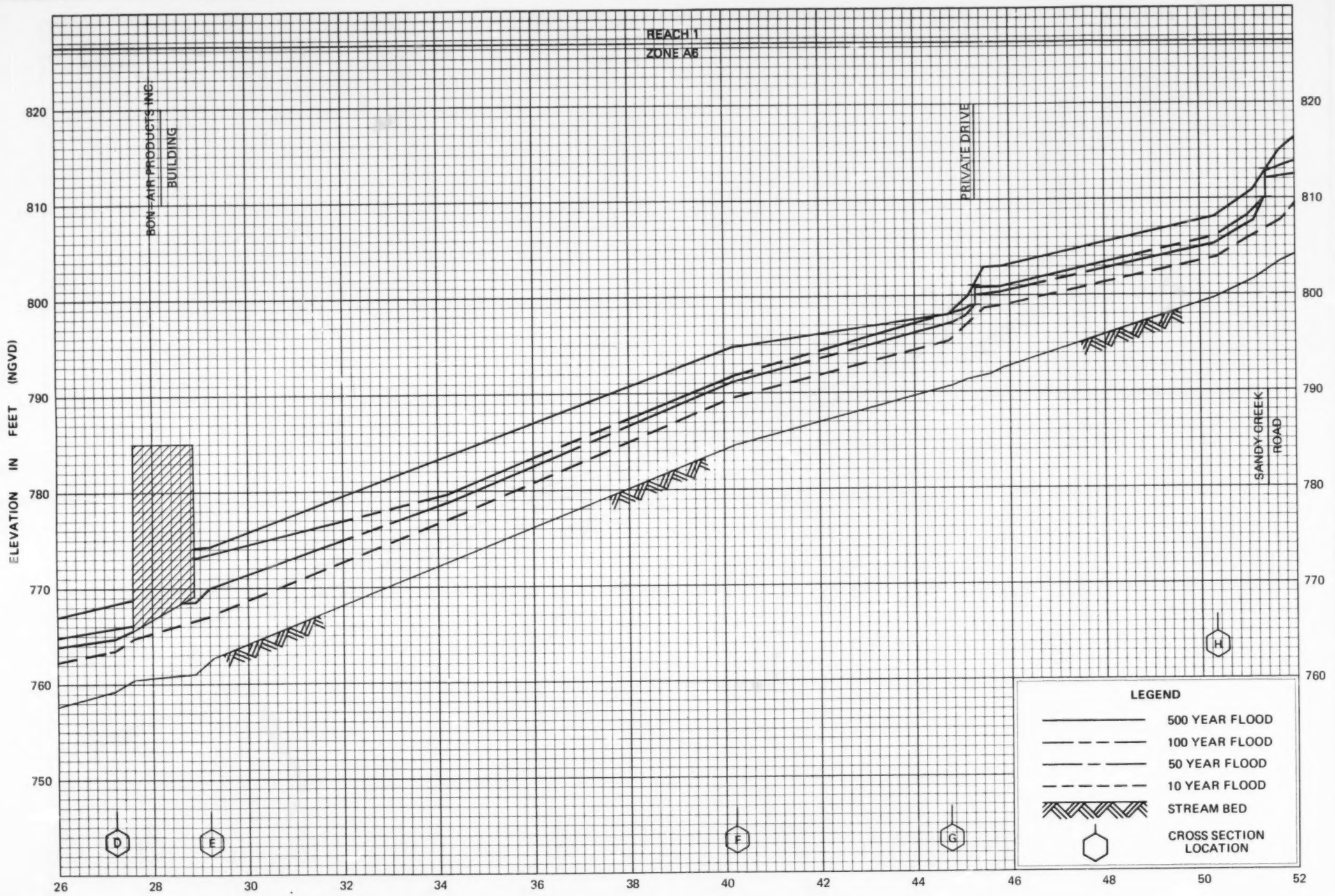
FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

MUNICIPALITY OF PENN HILLS, PA
(ALLEGHENY CO.)

FLOOD PROFILES

SANDY CREEK

REACH 1
ZONE A5



STREAM DISTANCE IN HUNDREDS OF FEET ABOVE CONFLUENCE WITH ALLEGHENY RIVER

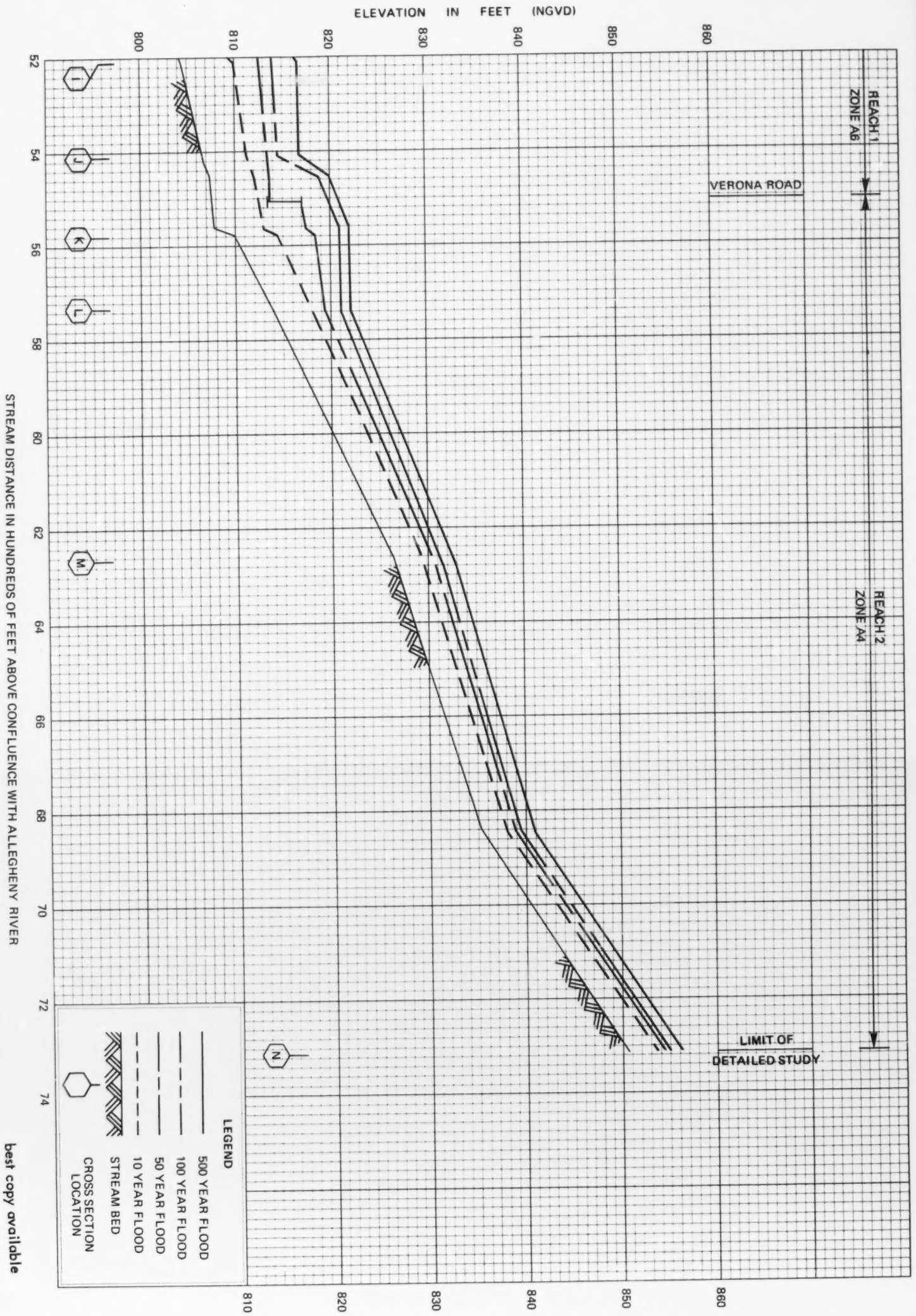
FLOOD PROFILES

SANDY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

MUNICIPALITY OF PENN HILLS, PA
(ALLEGHENY CO.)

08P



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